Central Technology Assessment Report for the ERP Requirements and Acquisition
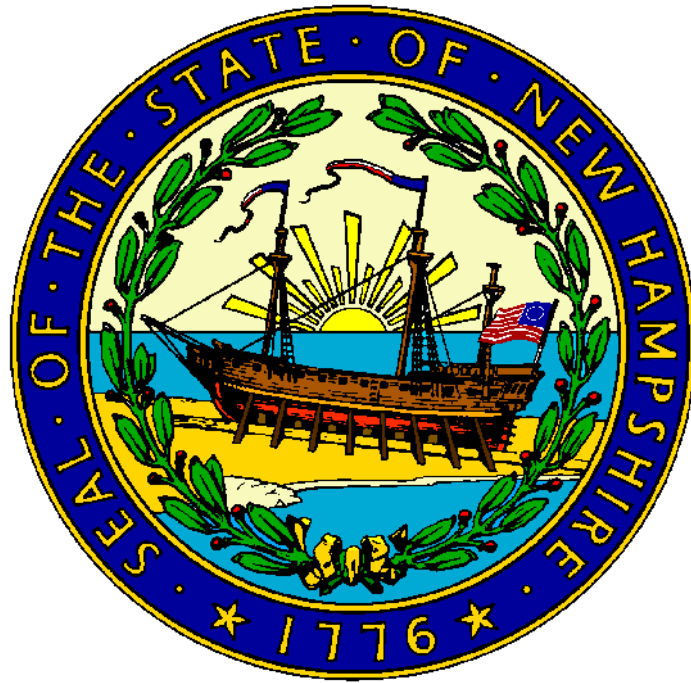
October 12, 2003

Table of Contents

1. Executive Summary

The MAXIMUS *Central Technology Assessment Report* is intended to support the evaluation and selection of an Enterprise Resource Planning (ERP) system for the State of New Hampshire. This deliverable provides an evaluation of the technical infrastructure of the State, in light of typical requirements for modern ERP systems.

Key findings from this assessment include:

- *Platform preferences*. OIT and DAS technical managers have expressed a preference for the HP-UX operating system and the Oracle relational database system. This combination appears to be well supported by the ERP offerings sampled for this report. These preferences should be further evaluated for possible inclusion as key technical requirements for the State's ERP system.

- *Server hardware*. OIT has a number of HP-UX systems in operation at the present time. These systems are dedicated to existing applications, which will necessitate the acquisition of new hardware for operation of the ERP system. Specific hardware configurations should be based upon sizing recommendations made by the selected ERP implementation vendor.

- *Workstations*. If existing workstation replacement efforts continue as planned, the State's workstations will likely meet the needs of an ERP system. The selected ERP vendor will need to provide the final requirements for workstation configurations, so additional upgrades may yet be necessary.

- *Data networks*. Recent upgrades to the Wide Area Network (WAN) and Local Area Networks (LANs) have positioned the State to support the demands of an ERP system. No changes to WAN/LAN systems are anticipated, but OIT should, with assistance from the selected ERP vendor, prepare detailed transaction models to more accurately assess capacity requirements.

MAXIMUS has recommended a series of steps that will facilitate the creation of detailed technical requirements that may be included in New Hampshire's ERP selection process.

2. Introduction

The State of New Hampshire's recent Strategic Information Technology Plan (SITP) identified the need for an ERP solution to streamline business processes, improve operational efficiencies, and increase employee empowerment. In accordance with the SITP, the Department of Administrative Services (DAS) authorized a feasibility study to identify alternatives for implementing such a solution. After assessing the alternatives, DAS decided to replace current systems and implement a new ERP.

MAXIMUS was engaged to guide the State through the selection of an ERP package and an implementation vendor. As part of its responsibility, MAXIMUS prepared this assessment of New Hampshire's current technical environment.

2.1   Purpose

As stated in the *Project Charter for ERP Requirements and Acquisition*, "This report will address the readiness of the State's central technology structure to support a state-of-the-art replacement ERP. It will also include recommended options for change to support the statewide implementation." This report presents the requirements for operating a modern ERP package, evaluates the capabilities of the State's current technology structure in that light and provides guidance on preparations for operating a new ERP system. This document will also provide needed background information to prospective implementation vendors on the State's current environment and capabilities.

2.2   Intended Audience

This report is directed to State business and technical manager, and other interested stakeholders of the ERP project. This document is intended to support their decision-making processes regarding the technical implementation of a new ERP system.

Additionally, this deliverable is directed to the vendor community, who will gain valuable insight into New Hampshire's technical environment.

2.3   Methodology

This assessment was prepared by following a progression of steps:

- *Document the current environment*. MAXIMUS used a combination of written documentation and telephone interviews with State IT managers to compile a picture of New Hampshire's current technical infrastructure.

- *Research system requirements*. MAXIMUS reviewed implementation options for four current ERP products from AMS, Oracle, PeopleSoft, and SAP.

- *Explore State preferences*. MAXIMUS reviewed the potential implementation scenarios with State technical leaders to establish a preferred technical platform.

- *Perform gap analysis*. MAXIMUS compared the capabilities of the current technical infrastructure against the requirements of ERP system.

- *Formulate recommendations*. Based on its findings, MAXIMUS prepared a series of recommendations for concrete steps that will prepare the State for its new ERP system.

This assessment document is structured to reflect this methodology.

2.4 Assumptions

This report is predicated on several assumptions about the manner in which DAS will procure and operate its new administrative systems. These assumptions are:

- *Operated in-house*. DAS will operate its financial systems in its own facilities, as opposed to operating the software through an Application Service Provider agreement. This assumption was made because this scenario would place the most demands upon the State's technical resources and personnel.

- *Dedicated equipment*. With the possible exception of mainframe-based solutions, The State will procure new equipment for the operation of its new systems instead of redeploying existing server resources. An initial review of the existing State systems did not show any significant opportunities for redeployment or consolidation of resources, so MAXIMUS pursued the worst-case scenario of new purchases.

3. Current Environment

This section provides a summary of the equipment and software that comprises the existing DAS technical environment. The State's *Strategic Information Technology Plan (SITP)*, published in December 2001, provided a base of information for this assessment. At the request of MAXIMUS, the State provided update information to ensure that assessment is based on the current environment.

3.1 Data Center Facilities

OIT operates three data center facilities. These data centers house a combination of mainframe, UNIX, and Intel systems, along with a variety of LAN and WAN gear. These facilities are true data centers, with raised, anti-static flooring, dedicated environmental controls, and power conditioning systems.

3.2 Mainframe Systems

The State's principal data assets are contained within mainframe-based systems. The New Hampshire Integrated Financial System (NHIFS) and the Government Human Resource System (GHRS) contain the bulk of the State-level operational data used by State agencies.

The Office of Information Technology (OIT) operates two independent mainframe systems. The mainframe hosting the state's present administrative systems is a two-way IBM Multiprise 2003-225 of 67 MIPS capacity. This system employs the VSE/ESA 2.6 operating system under z/VM 3.1, and the CICS transaction server. This mainframe is divided into multiple VSE/ESA virtual machines. The financial applications operate on one production VSE machine, PRD3, which has six (6) CICS teleprocessing regions supporting agency access and input of data, and one development VSE machine, DEV3, which has five (5) CICS teleprocessing regions. Each development region is sized to accommodate full copies of production application data to support testing and development.

The second mainframe, which hosts applications for the New Heights system, is an IBM z800-0A2 system of 271 MIPS capacity. This system utilizes the z/OS 1.4 operating system and the CICS transaction server. Details on both systems are contained in Appendix A.

3.3 Intel Server Systems

DAS operates approximately forty Intel-based servers, using a combination of Microsoft Windows NT, Windows 2000, and Windows 2003 operating systems. These systems fall into two general usage categories: basic network services and application services.

The servers providing basic network services perform the following tasks:

- User directory and authentication;

- File server;

- Print server;

- Electronic mail; and

- Internet access.

The user directory services are currently based on Windows NT domains. DAS is currently migrating to Windows 2000 Active Directory services.

Beyond these basic services, DAS uses Windows servers to provide application functionality. The primary example of this task is hosting the Attachmate Web-to-Host product that gives DAS users Web-based access to the NHIFS and GHRS applications.

Other important Windows-hosted applications are the e-Info Warehouse Services and e-Info Request Services (previously referred to as GOLD). These applications provide agencies access to 12 years of current and historical Financial and Human Resource information, with the ability to create and schedule their own queries and reports using e-Info Warehouse, or to request information from a master library of pre-written reports or define their own unique report specifications using e-Info Request. The e-Info Warehouse (GOLD) offers reporting, querying, and extraction capabilities in support of decision-making processes, the monitoring of the effects of decisions made, auditing, trend analysis, historical research, etc. It currently supports "Power Users" with fat-client software and "Web Users" with thin-client software, with the ability soon to provide all users with zero-client access.

The e-Info Library Services, another Windows-hosted application, is an electronic library that enables viewing all agency reports generated by the State's budget, financial and human resource systems. All reports generated by these systems are viewable in a web-browser by any authorized user from their NHSUN connected desktop. e-Info Library Services will be an official State Archive repository. Agencies will no longer be required to archive their own paper copies of reports from these State computer systems.

The servers supporting the data warehouse and report library systems are detailed in Appendix B.

In addition to its own users, DAS hosts Windows systems that serve the following entities:

- Governor's Office;

- Executive Council;

- Commission on the Status of Women;

- Governor's Office of Energy and Community Services; and

- Governor's Office on Disability.

Other agencies operate Intel servers independently of DAS. These systems are generally similar to those of DAS.

3.4   UNIX Server Systems

OIT operates a number of UNIX systems. OIT has standardized on Hewlett Packard's HP-UX operating system and its corresponding UNIX server line. Systems currently operated by OIT include the following:

OIT HP-UX Systems

Quantity	Model	Processors	RAM
1	HP N4000-44	8 x 440 MHZ	12 GB
1	HP A502	2 x 440 MHZ	1.5 GB
1	HP K570	2 x 200 MHZ	3 GB
1	HP K580	4 x 240 MHZ	3 GB
2	HP RP5470	2 x 750 MHZ	5 GB
1	HP RP7410	4 x 650 MHZ	8 GB
1	HP N4000-75	4 x 750 MHZ	8 GB

These following software packages are installed on these systems:

- HP-UX 11.11;

- Oracle (8i, 9.2);

- HP Data Protector;

- HP MirrordiskUX;

- HP Online JFS;

- HP Glance Plus; and

- Dollar Universe (Scheduler).

These systems utilize Storage Area Networks (SANs) for their storage requirements. OIT uses various Hewlett-Packard and EMC SAN products, with capacities ranging from 1.3 to 3.0 Terabytes. Details of OIT's HP-UX systems are contained in Appendix C.

In addition, the Department of Public safety operates a number of HP-UX systems, as well. These systems differ in configuration by use of clustering of the Oracle environment.

3.5 Workstations

DAS users are provided with workstation computers at their desks. These workstations are predominately Dell Optiplex systems running Windows NT 4.0 Workstation, Windows 95, or Windows 2000 operating systems.

DAS has created a standard package of applications for it users, based on the Microsoft Office 2000 productivity suite. The standard software package includes:

- Word;

- Excel;

- Access;

- PowerPoint;

- Outlook 98;

- Internet Explorer; and

- Norton Antivirus.

DAS users are not restricted to these applications. Additional software is available to meet specialized needs, including:

- Quota Manager Inquiry;

- Cute_ftp;

- SQL Client;

- Crystal Reports;

- Monarch;

- Extra Personal Client

- Microsoft Project;

- Calendar Creator

- Visio;

- Flowcharting PDQ;

- AutoCad;

- Adobe Acrobat Reader;

- FMS Total Access Suite;

- FrontPage;

- PKZIP;

- Quickbooks; and

- Visual Basic.

The State is implementing an upgrade program to refresh its workstation inventory. Within the next 18 months, the State expects to remove the last of its Windows 95 systems. All new systems use the Windows XP operating system, and are powered by Pentium 4 processors of 1.8 GHz or more. At the conclusion of that upgrade cycle, the minimum workstation configuration is expected to be a Pentium III system with the Windows 2000 operating system.

Implementation vendors should be asked to make recommendations for minimum workstation configurations in their proposals. This will give the State an opportunity to plan any additional changes to its workstations.

3.6   Local Area Network

The Office of Information Technology is responsible for the operation of the DAS Local Area Network (DAS LAN). The DAS LAN is implemented across five physical locations using the Microsoft Back Office suite to provide services. The State House Annex, the Administrative Services Data Center (ASDC), the Human Rights Commission, the Judicial Conduct Commission, and the Office of State Planning and Energy are linked through the WAN provided by NHSUN. Each Division within Administrative Services and various sections within the Governor's Office are able to take advantage of the services provided through this network.

The DAS LAN has been upgraded to accommodate steadily increasing demands for bandwidth. DAS LAN is a TCP/IP network based on a mixed copper/fiber Ethernet infrastructure. Most divisions are equipped with 100bT switched Ethernet cable plants. The divisions are linked by 1 Gbit Fiber connections. The basic LAN structure is shown below.

Administrative Services LAN Infrastructure
Annex / State House
Proposed
Nov. 17, 2001
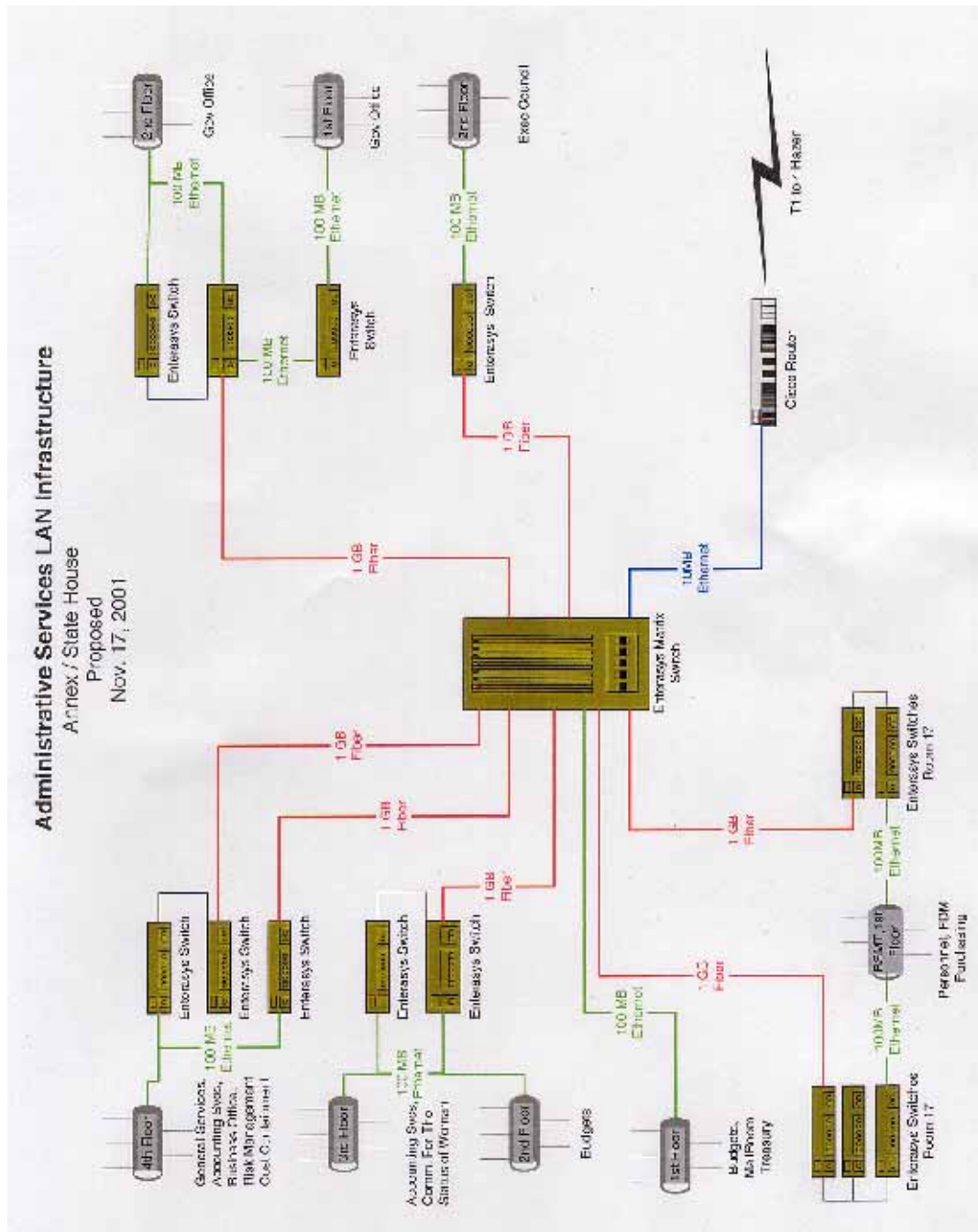
3.7 Wide Area Network

The New Hampshire Wide Area Network (WAN), known as NH SUN (New Hampshire State Unified Network), is operated by the WAN Services Group of OIT. NH SUN performs three services. It acts as an Intranet interconnecting almost all State Agencies/Boards/Commissions (A/B/C's). In this role, it provides the primary means of access to the present financial and human resources systems. It is principally a Metro Area Network (MAN), with few links going beyond the Concord City limits. Secondly, it acts as an Internet Service Provider (ISP) to client entities and includes a centralized Domain Name Server (DNS). NH SUN connects to the Internet via two separate vendors and two geographically dispersed locations. The third service connects selected State partners (Extranet) to the NH SUN network. This is done via a State-owned Virtual Private Network (VPN) that incorporates secure authentication provided by CryptoCard.

The WAN architecture is a modified hub-and-spoke system. The hub is composed of a ring of three interconnected nodes making up the network backbone, with spokes reaching out to the outlying State entities. Virtually all agencies are connected to NHSUN in this manner. The backbone is an ATM ring connecting, via leased lines, the State Office Park East (SOPE) to the Capital Area at 25 Capital Street and on to the State Office Park South (SOPS). The return from SOPS to SOPE is via an OC-3 microwave link. This design provides a measure of fault tolerance: if a link should fail, traffic will be routed around the system in the other direction to reach its destination. The leased links in the system are registered with the Federal Office of Priority Telecommunications (OPT) for Telecommunications Service Priority. This requires Verizon, the State's telecommunications provider, to make restoration, in case of a link failure, a federal priority.

The remote sites are connected into the hub via a variety of media. Media selection is based upon the optimum price/performance ratio that meets the requirements of the node in question. The network supports ISDN, frame relay, DSL, point-to-point connections, wireless, and directly-connected CAT5 and fiber Ethernet links. All critical data links are backed up by an alternate media transport, which is automatically engaged by the edge router.

The State has standardized on Cisco products for implementation of the WAN. A range of router models are in use, with selection based on media required for the location.

NH SUN operates redundant Cisco PIX firewalls and a Cisco Intrusion Detection System (IDS) at each of the Internet interfaces. The edge routers at each location perform some firewall services as well, protecting the offices from each other on the Intranet. All LAN locations employ private addressing for the internal network, with the edge routers using address translation to present external addresses to the WAN.

3.8 Systems Management

The WAN Services Group uses a home-grown, Linux-based application for management of the NH SUN network. This application performs the basic network management functions of commercial applications, providing up/down status monitoring and performance measurement.

3.9 Application Support

The division of Financial Data Management (FDM) is responsible for support of the existing financial applications. The Help Desk is composed of four FTEs supporting the existing financial applications. Additionally, there are 10 application developers supporting these applications and five FTEs supporting new Web applications and the Data Warehouse.

4. Future Environment

New Hampshire will have considerable flexibility in choosing the technical environment in which its new ERP system will operate. This section outlines the technical foundations of current ERP systems, and describes the several possible deployment scenarios.

4.1 ERP System Platforms

Most top-tier ERP packages are now Web-based applications, using a Browser for their user interfaces. This architecture reflects industry trends in application, and does offer significant advantages in terms of ease of maintenance and deployment. At the same time, most of the top-tier ERP package vendors support several platforms for their products, offering customers several choices of operating systems and databases. This section presents a survey of the supported platforms of several vendors.

The vendors selected for this report were chosen to represent a cross-section of the ERP marketplace. A vendor's inclusion in this list does not constitute an endorsement by MAXIMUS, nor a judgment about the suitability of their products for the needs of the State.

4.1.1 AMS Advantage

Version 3 of the AMS Advantage product is a Web-enabled system based on the Java 2, Enterprise Edition (J2EE) platform. AMS has built their product on the IBM WebSphere application server, which runs on a range of server operating systems. The following table lists AMS Advantage platforms.
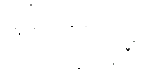
AMS Advantage Platforms	
Server Operating Systems	Databases
Microsoft Windows NT/2000/2003	Oracle
IBM AIX	IBM DB2
IBM zOS	MS SQL Server
HP-UX	
Solaris	
Linux	

4.1.2 Oracle E-Business Suite

The Oracle E-Business Suite is also a Web-enabled system based on the Java 2, Enterprise Edition (J2EE) platform. Oracle has built its product on its own commercial application server, which runs on a range of server operating systems. Oracle only supports its own database system.

Oracle E-Business Suite Platforms	
Server Operating Systems	Databases
Microsoft Windows NT/2000	Oracle
IBM AIX	
Tru64 UNIX	
HP-UX	
Solaris	
Linux	

4.1.3 PeopleSoft 8

PeopleSoft 8 represents a shift of that company's product to a Web-enabled system. PeopleSoft supports a range of operating systems and databases. The following table lists PeopleSoft8 platforms.

PeopleSoft 8 Platforms	
Server Operating Systems	**Databases**
Microsoft Windows NT/2000	**Oracle**
IBM AIX	**IBM DB2**
IBM OS/390	**IBM DBS UDB for OS/390**
Tru64 UNIX	**MS SQL Server**
HP-UX	**Sybase**
Solaris	**Informix**

4.1.4   SAP mySAP

SAP's mySAP products are fully Web-enabled, based on the SAP NetWeaver application server, and are supported on a number of server operating systems and databases. Traditional "fat client" applications are still a supported option. The following table lists SAP mySAP platforms.

SAP mySAP Platforms	
Server Operating Systems	**Databases**
Microsoft Windows NT/2000	**Oracle**
IBM AIX	**IBM DB2**
IBM OS/390	**MS SQL Server**
IBM AS/400	**Informix**
HP-UX	**ADABAS**
Solaris	
Linux	

4.2   ERP Architectural Considerations

As can be seen from the product descriptions above, choosing an ERP package does not dictate the platform on which that product will operate. The choice of an operating

platform should be treated as a strategic decision, based on concrete factors. The following criteria are should be considered a starting point for consideration.

4.2.1   Organizational Preferences

New Hampshire may consider preferences for a particular platform, as long as these preferences are based on practical considerations. For example, some organizations choose to continue using mainframe systems because they have special expertise in mainframe operations. Others choose Microsoft products to fit into an end-to-end Microsoft enterprise platform.

DAS and OIT technical managers have expressed a preference for operating the State's new ERP system on the HP-UX platform, with an Oracle database. OIT has developed special expertise in the operation of applications based on this combination, and has the in-house expertise to support them. In contrast, the State relies heavily on contractors to support its mainframe systems, and has little staff expertise in this area.

The combination of HP-UX and Oracle appears to enjoy significant vendor support. All four of the ERP packages surveyed for this deliverable support these tools. Oracle is a leader in the database field, and has grown a large market share in high-end database applications. HP-UX continues to receive strong support from Hewlett-Packard, and will likely remain a leading UNIX platform for years to come.

4.2.2   Sizing Requirements

Application performance is critical to the overall success of any ERP implementation. A critical factor in achieving satisfactory performance is matching the operating platform to the expected load. Sizing requirements are therefore critical to platform selection. Windows-based solutions may be a logical choice for a low-volume system. At the high end, mainframe-based systems may be the most effective choice. At the broad range in between where a number of platforms like HP-UX may be considered, a balance must be struck between capability and complexity. MAXIMUS recommends that the State require vendors provide preliminary system sizing in their proposals, based on information provided by the State. The State should use this sizing data to ensure that its preferred platform is appropriate for the anticipated workload. This process is described in more detail in section 6.2, and a template for sizing inputs has been provided as Appendix D. Vendors should also be encouraged to propose alternate platforms that may better fit the calculated workload.

### *4.2.3   Total Cost of Ownership*

Total Cost of Ownership (TCO) includes all of the expenditures required for the acquisition and operation of a product. Some may argue that TCO is the "trump card" among selection factors. At a minimum, it should be treated as a tie-breaker among competing platforms. For example, consider two candidate platforms: one is based on a

single, large server; the other is comprised of a cluster of smaller servers. If both of these hypothetical systems will meet the application's sizing requirements, the system with the lowest TCO should be selected. MAXIMUS recommends that the State break out hardware costs as a line item in their cost proposals. The State should be prepared to extrapolate its current operational expenses to the vendor-proposed solutions in order to evaluate environment TCO over a period time, such as five or ten years.

4.3 Scenario 1: Mainframe

OIT will have the option of creating a mainframe-based platform to operate any of several ERP packages. This type of solution has the advantage of leveraging existing expertise in mainframe operations. Another advantage is that mainframe capacity could be divided between the ERP applications and other legacy systems that might remain in use. This monolithic approach is an example of "scaling up" to meet high performance requirements. The main disadvantage of a mainframe solution is its relatively high costs, making it hard to justify for small to moderate workloads.

Workstation

Mainframe
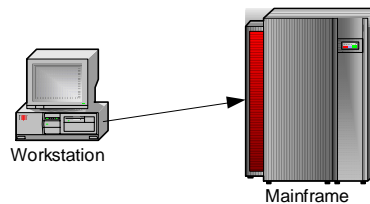
4.4 Scenario 2: Windows Servers

Windows-based ERP platforms offer tremendous flexibility in their architecture. Windows platforms can be adapted to serve small through medium-high transaction loads. Scaling may be accomplished through a combination of server sizing and clustering. Larger servers reduce the complexity of an installation, but the use of several smaller servers offers fine-grained control over resource utilization. Windows servers are typically deployed with the logical tiers of the application (presentation, application logic, and database) residing on separate physical systems or clusters of systems. This is an example of "scaling out" to meet performance requirements. The principal advantage of a Windows-based solution is its relatively low cost. The disadvantage of this type of solution is the complexity of managing multiple servers and clusters.
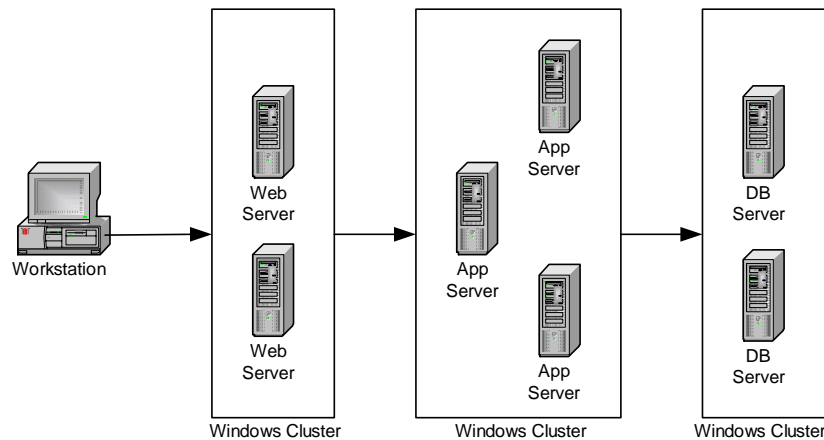
4.5   Scenario 3: UNIX Servers

UNIX-based ERP platforms also offer tremendous architectural flexibility. UNIX platforms such as HP-UX are normally employed for medium to high transaction loads. Like Windows systems, scaling may be accomplished through a combination of server sizing and clustering. Because UNIX servers are available in a variety of high-end configurations, clustering is often done for reasons of fault tolerance instead of performance. Many physical implementations are possible with UNIX systems, but common scenarios involve physical separation of the application tiers. The advantages of a UNIX solution are moderate cost, flexibility, and the State's existing operational expertise.
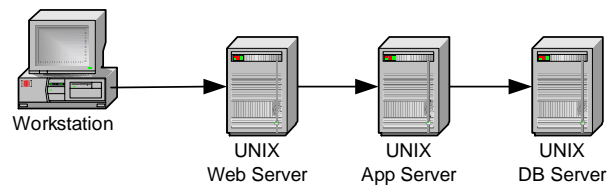
4.6   Scenario 4: Mixed Environment

New Hampshire need not be confined to a single server platform for its ERP system. Most of the top-tier vendors will support a mixed environment, with components selected individually according to cost and performance. For example, one common scenario involves Windows servers deployed for the Web and Application Server tiers of the application, combined with a large UNIX server for the database platform. The advantage of such and approach is economics; the State can apply resources to meet the demands of each application tier. The principal disadvantage is the complexity of managing multiple types of systems.

Workstation → Web Server / Web Server (Windows Cluster) → App Server / App Server / App Server (Windows Cluster) → UNIX DB Server
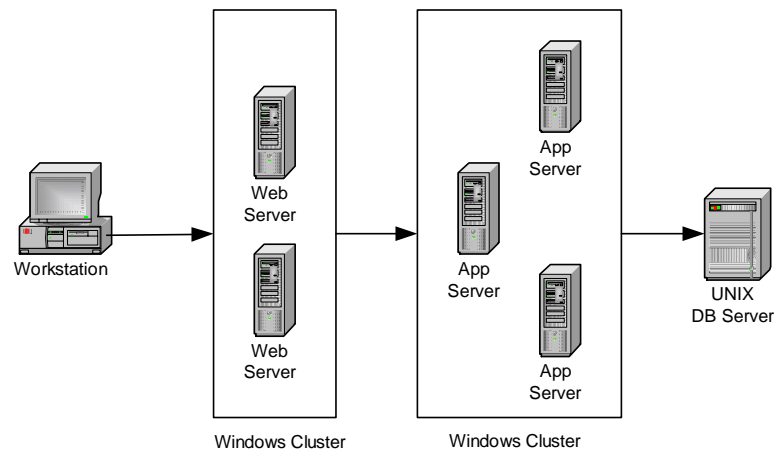
5. Gap Analysis

This section examines each of the technology areas presented earlier. For each technology, MAXIMUS has made a preliminary evaluation of its suitability to support a modern ERP system. Without the benefit of detailed performance or other technical requirements, only general conclusions may be made.

5.1   Data Center Facilities

The data center facilities operated by OIT would appear to meet the needs of any of the ERP deployment scenarios described in this report. The data centers have the capacity to absorb the increased workload a new ERP system would add.

5.2   Mainframe Systems

The Multiprise 2000 mainframe system that hosts the legacy NHIFS software is an older model, entry-level system. This unit will be reaching the end of its useful life around the time that an ERP deployment could be completed. As a result, this system is not a good candidate for the State's new ERP solution.

The z800 system is relatively new, and offers greater expansion options than the Multiprise 2000. The Gartner Group, a leading technology industry research firm, expects the z800 to remain a viable platform for enterprise applications for several years to come.[1] Additionally, the zOS operating system it uses has been developed to support the Web technologies underpinning most modern ERP packages. These factors make the z800 a much stronger candidate for an ERP platform. Several factors would have to be considered to determine the viability of this platform, including:

---

1 "z800 Useful-Life Outlook," Research Note M-17-0515

- *Existing plans*. This system may be "spoken for," or otherwise precluded from consideration; and

- *Capacity*. The z800's utilization will need to be carefully analyzed to determine if new ERP workload could be added, either in its present configuration or with appropriate system upgrades.

If the existing z800 cannot be used for one reason or another, the State could consider leasing a new mainframe to host the ERP applications. This would be a relatively expensive option, but may be justified if the workload and TCO analysis show it is reasonable. The costs of new mainframe systems have dropped considerably in the last several years as IBM has worked to make their zSeries systems more attractive. The Gartner Group reports that IBM's most recent pricing changes make some mainframe systems cost-competitive with high-end UNIX systems.[2]

5.3   Intel Server Systems

Many of the Intel servers in place in the current environment will continue to provide specific network services or applications after deployment of the new ERP system. Redeploying these resources to a new ERP system is therefore not a realistic option.

The State's choice in ERP applications will impact its existing reporting and data warehouse applications. All of the top-tier ERP vendors surveyed for this report include data warehousing components (sometimes called business intelligence) in their offerings. It will likely be more cost effective to purchase the vendor's packaged data warehouse module than to re-develop the State's data warehouse application. The hardware used for the existing data warehouse application may or may not be able to support the vendor's data warehouse components. The State must first decide if it wishes to run the data warehouse module on the HP-UX platform with the main ERP components, or continue with the Intel platform. Even if data warehousing were to continue on the Intel platform, the usability of the hardware will depend upon the specific requirements of the vendor's software and the sizing requirements driven by the volume of data to be included in the system.

The impact of the ERP system on the e-Info Library Services system will require detailed assessment by the selected ERP vendor. The State's system may well be adaptable to the reports generated by the ERP system, but integration efforts will depend upon the built-in or third-party reporting tools used by the selected vendor.

5.4   UNIX Server Systems

Like their Intel counterparts, the UNIX server systems in place in the current environment are dedicated to specific network services or applications. Redeploying these resources to

---

2 "IBM Cuts Prices, Emphasizes Mainframe Viability," First Take FT-20-8714

a new ERP system is likely not a realistic option. If the State were to pursue a HP-UX-based ERP platform, as is its preference, new servers and SAN subsystems should be purchased.

5.5   Workstations

The move to Web-based ERP applications changed the litmus test for minimum workstation requirements. In the past, minimum workstation specifications were driven by the needs of the ERP application client software. These "fat clients" contained performed much of the work of the system, and as a result they carried heavy resource demands. With Web-based ERP packages, the Browser is merely a display device and its resource requirements are modest. In general, a workstation capable of running Office 2000 and Internet Explorer 5.5 will generally work well as an ERP client.

As noted earlier, it is expected that interested implementation vendors will include in their proposals any recommended workstation configurations.

5.6   Local Area Network

Perceived performance of Web-based applications is heavily dependent on the capabilities of the local area network employed. Excellent performance from the server platform may be wasted if the "last mile" of bandwidth to the user's desktop is not sufficient to carry the traffic required. The State's LANs, with their recent upgrades, are of a modern design that offers the potential for high throughput. Transaction modeling and load testing will be required to make a definitive determination about the adequacy of the existing LAN environment.

OIT will be responsible for the operation of the State's LAN environments, and will be responsible for the performance of these systems.

5.7   Wide Area Network

The NH SUN wide area network has been upgraded recently and will likely meet the needs of a new ERP system. OIT has the tools it needs to monitor latency and utilization, and the capability to add capacity as required. Again, transaction modeling should be performed to help the WAN Group estimate future loads and plan its capacity needs.

5.8   Systems Management

OIT has systems management tools in place that are sufficient for monitoring its network systems. Additional software tools may be required, however, to support the ERP server platform. New UNIX or Windows systems may require specialized tools to monitor system health and status, and to manage their maintenance needs. The usual mainframe toolsets may be sufficient, if that is the chosen platform.

Many commonly used tools, such as those from Aprisma, Concord, and Tivoli, are capable of monitoring both the ERP servers and the network infrastructure. These tools are expensive, however, and may be hard to justify unless deployed on a broader scale than just the ERP environment. Newer vendors, such as Empirix, are offering tools tailored for Web-based application management and may be more cost effective if the scope of the management solution is defined more narrowly.

OIT can either specify a set of tools that its ERP vendor must support, or it may make the recommendation of management tools a required part of the vendor's proposals. A key factor in this decision will be the State's choice of a broad-based or narrowly focused management strategy.

5.9 Help Desk

At the time of this assessment, the support structure for the new ERP applications had not been determined. Therefore, it is difficult to determine the adequacy of any particular support structure. The demands for user support normally peak in a short period following system deployment. It is common practice for ERP vendors to supplement their client's staff during initial implementation. MAXIMUS anticipates that a structure similar to that of the NHIFS applications would be feasible given sufficient resources are made available by the implementation vendor. The expectations for support resources will need to be clearly stated in New Hampshire's RFP.

6. Next Steps

The findings of this assessment provide a "big picture" view of the fit between New Hampshire's technology infrastructure and the operational needs of a state-of-the-art ERP system. In order to make detailed plans for the purchase of new hardware or other technical enhancements, the State will need to work with its vendors to create a more detailed picture of the system's capacity requirements. MAXIMUS recommends that the State undertake a series of actions that will clarify the technical demands of the future ERP application and allow for detailed planning and preparation by both the State and its vendors. These recommended actions are discussed below.

6.1 Requirements Definition

System specification begins with the definition of requirements. These requirements will be used to define the range of solutions that will satisfy the State's needs. The technical ERP requirements should be specific and measurable so that compliance can be easily determined. These requirements should also be categorized as "hard" requirements that must be met, or as "soft" requirement that may be considered optional. An example of a hard requirement might be the use of a browser-based client, with no application code

being loaded to the workstation. A soft requirement may be compatibility with a favored, but not required, software component.

The platform preferences expressed by DAS and OIT technical managers should be reviewed as part of this process. The mandated or recommended use of HP-UX and Oracle would become key technical requirements that would significantly shape the responses from interested implementation vendors.

MAXIMUS has proposed to seed the overall ERP requirements gathering process with requirements drawn from systems projects in other states. The database of requirements contains a number of items in technical categories that may be used to give New Hampshire a head start in this process. MAXIMUS will lead a review of these requirements and an exploration of any new requirements that are needed to address New Hampshire's unique needs.

6.2   Preliminary Sizing

Vendors should be asked to perform detailed sizing calculations in the preparation of their proposals. System sizing will drive not only the hardware requirements, but also the level of effort for such activities as conversions, batch processing, and reporting.

MAXIMUS recommends that the State require that vendors include the results of their sizing exercises in their proposals for State review. Vendors will occasionally show considerable variation in their sizing requirements, and the State will want to compare the methods and assumptions used by the vendors.

The Gartner Group has presented a general methodology for sizing ERP applications.[3] While its methodology is focused on SAP systems, the basic process can be applied to software from any vendor, and is useful for understanding the process most vendors would use. Gartner recommends the use of a *transaction volume* method, which takes into account the number and type of transactions to be processes in a given peak period. From benchmarking data compiled by the software company, the implementation vendor will be able to derive the hardware resources required. Gartner recommends the following general steps be taken to size the system:

- *Calculate business workload*. The sizing input data is used to determine peak workload. All assumptions should be documented;

- *Specify server parameters*. Benchmarking data should be used to determine the hardware sizing. The number of concurrent users is often the primary driver for memory requirements. On the other hand, transaction volumes and retention periods will usually determine storage requirements; and

---

3 "Sizing SAP Server: Art or Science?" Research Note TU-08-0300

- *Optimize system design*. Once the general server parameters are known, the vendor will be able to create a detailed design that takes into account installation-specific requirements such as the racking arrangement needed to fit into the available space in the data center.

Gartner goes on to recommend specific outputs of this sizing process:

- All written sizing assumptions made;

- Total peak business workload;

- Expected average CPU utilization of each server, when live;

- Design capacity, at these utilizations levels;

- Ultimate capacity of the same system, at 100 percent CPU utilization;

- Headroom, which equals ultimate capacity minus design capacity;

- Reduction in design capacity, if any, with database server failover, if configured; and

- How does the configuration change if the business workload grows by some arbitrary amount (50%, 100%)?

Each vendor may have its own specific process for sizing a solution, but the methods and results will be similar. The ultimate outcome of this process will be a set of specifications of sufficient detail that either the vendor or the State could procure the appropriate hardware.

To facilitate this level of analysis, the State should include the required sizing inputs in its RFP. This information should include, at a minimum:

- Total system users;

- Peak number of concurrent users;

- Off-peak number of concurrent users;

- Breakdown of users by role or type (e.g.: accounts payable, HR, etc.);

- Typical transaction size by role or type (e.g.: invoice with X lines);

- Number of transactions per user per month by role or type; and

- Amount of historical data to be kept online (e.g.: three years).

Appendix D contains a worksheet to be filled with preliminary data. The vendors will use these assumptions in combination with their benchmarking data to derive a solution. The State should be prepared to supply additional information during the question and answer phase of the selection process, as different vendors may require different sizing inputs.

The State may consider offering vendors the option of recommending solutions based upon its favored platform, HP-UX, and any other platform that the vendor feels may be more cost effective.

6.3   Preliminary Preparations

Once a vendor's solution has been selected, and the shape of the technical environment is known, OIT can begin making preliminary preparations for environment setup. For example, the data center could be provisioned to accommodate the planned servers, or management software tools could be purchased for the target operating system.

6.4   Final Sizing

Early in the implementation phase, the selected vendor should prepare a final hardware specification that will be used for the procurement of the required systems. The State may consider requiring the vendor to prepare Systems Architecture and Capacity Analysis deliverables that validate and refine the sizing done previously. These deliverables would serve as a detailed design of the ERP server environment, and would document the expected impact on the State's network.

6.5   Final Preparations

With a detailed design in hand, the State can make final preparations of the technical environment. This will include arranging for installation and configuration of all required hardware. This should also include creating detailed bandwidth estimates, so that network testing can take place. Sufficient time will need to be allotted for installation of the systems and any necessary changes in network structure or media.

Appendix A: DAS Mainframe Systems

This appendix contains the software configuration of the existing mainframe systems operated by DAS.

z800-0A2   271 MIPS   44 MSUs

Vendor	Product Name	Version/Release
IBM	z/OS	V1R4
	DB2 Universal Database for z/OS	V7
	CICS/Transaction Server	V2R2
	Enterprise Cobol	V3R2
	DFSMS w/DFSMSdss & DFSMShsm	V1R3
	Security Server	V1R4
	Fault Analyzer	V3R1
	File Manager	V3R1
	PSF for z/OS	V3R1
	TSO Pipelines	
Computer Associates	DB2 Tools	P99G
	Database Analyzer	
	Plan Analyzer	
	RC/Migrator	
	RC/Query	
	RC/Update	
	Detector	
	CA-1	
	Deliver	V1R7
	Deliver TSO/ISPF Interface	V1R7
	DRAS	V1R0
	Endevor for OS/390	V3R9
	Endevor Automatic Config Manager	V3R9
	Endevor Extended Processor	V3R9
	Endevor External Security Interface	V3R9
	Framework	V2R2
	Intertest for CICS	V6R1
	Intertest Batch	V3R0
	JCLCHECK	V7R0
	CA-1	V5R2
	VIEW	V2.0
	VIEW TSO/ISPF Interface	V2.0
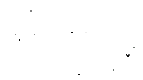
Allen Systems Group	TMON-MVS	V3.0
	TMON-CICS	V2.1
	TMON-DB2	V3.3
	Zeke for z/OS	V5.2
	OASIS	V2.4
Proginet	TransAccess Hub	V2R4M1
Chicago Soft	Quick Ref	V6R0
Sterling	Connect:Direct	V4R3
Group 1 Software	Code 1 Plus	V2R5M1
Syncsort	Syncsort for z/OS 1.4	V1R1BN
LRS	VPS	V1R8

Multiprise 2003-225   67 Mips   11 MSUs

Vendor	Product Name	Version/Release
IBM - VM	z/VM	V3R1
	RSCS	V3R2
	ACF/VTAM	V4R2
Computer Associates - VM	Dynam/T/VM	Rel 2.3
	CIS for VM	Rel 1.0
	Explore/VM	Rel 4.3
	VM:Secure	
	VM:Backup-HiDRO	Rel 2.7
IBM - VSE	VSE/ESA	V2R6
	HLASM	V1R4
	EREP VERSION	V3R5
	ACF/VTAM	V4R2
	DITTO/ESA	V1R3
	CICS TS FOR VSE	V1R1
	VSE REXX/OLTEP	V6R6
	VSE CONNECTOR	V6R6
	LE/VSE COBOL	V1R4
	LE/VSE BASE	V1R4
	VSE AF/PWR/VSAM MACROS	V6R6

	VSE CENTRAL FUNCTIONS	V6R6
	ICKDSF	V1R17
Computer Associates - VSE	Dynam/T/VSE	Rel 6.0
	Dynam/D/VSE	Rel 6.0
	CIS for VSE	Rel 1.4
	MASTERCAT (ISM)	Rel 3.3
	Easytrieve Plus	Rel 6.3
	FAVER2	Rel 3.5
	Explore/CICS	Rel 6.8
	Explore/VSE	Rel 6.8
	RAPS for VSE	Rel 5.0
CSI International - VSE	BIM-FAQS/ASO	Rel 5.2C
	BIM-GSS	Rel 5.2C
	BIM-ALERT/CICS	Rel 5.1C
	BIM-BUFF/VSE	Rel 2.0E
	BIMVSR/VSE	Rel 1.0I
	Dr.D	Rel 6.7B
MacKinney - VSE	CICS Morning News	Rel 3.1
	CICS Message	Rel 5.1
	COBOL Glossary	Rel 4.1
	Track	?
	X-Ray	?
Syncsort - VSE	Syncsort for VSE/ESA	Rel 3.4C
Allen Systems Group - VSE	Zeke for VSE/ESA	Rel 5.2.0A
illustro - VSE	CMS Access	n/a
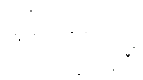
Appendix B: Data Warehouse and Document Management Systems

This appendix contains the hardware and software configuration of DAS's existing Intel Server Systems supporting the Data Warehouse (GOLD) and the Electronic Document Management System (e-Info Library).

DAS Intel Server Systems			
Quantity	**Model**	**Processors**	**RAM**
3	Compaq Proliant ML530	PIII Xeon 4 x 1000 MHZ 2 x 800MHZ	4GB
1	Compaq Proliant 7000	PII Xeon 4 x 400 MHZ	1GB
1	Compaq Proliant ML370	PII Xeon 1 x 733 MHZ	256MB
4	HP Proliant ML370 G3	PIII Xeon 2 x 2.4GHz	4GB

The following software packages are installed on these systems:

- SQL (7.0, 2000)

- Microsoft Outlook

- Norton Antivirus

- Veritas Backup Exec

- FTP

- Crystal Decisions

- IIS

- IE

- FileNET Report Manager, Image Services, and Web Services

- pcAnywhere

These systems utilize Storage Area Networks (SANs) for some of their data storage needs.

Appendix C: OIT HP-UX Systems

This appendix contains the hardware and software configuration of OIT's existing HP-UX systems.

OIT HP-UX Systems			
Quantity	Model	Processors	RAM
1	HP N4000-44	8 x 440 MHZ	12 GB
1	HP A502	2 x 440 MHZ	1.5 GB
1	HP K570	2 x 200 MHZ	3 GB
1	HP K580	4 x 240 MHZ	3 GB
2	HP RP5470	2 x 750 MHZ	5 GB
1	HP RP7410	4 x 650 MHZ	8 GB
1	HP N4000-75	4 x 750 MHZ	8 GB

These following software packages are installed on these systems:

- HP-UX 11.11;

- Oracle (8i, 9.2);

- HP Data Protector;

- HP MirrordiskUX;

- HP Online JFS;

- HP Glance Plus; and

- Dollar Universe (Scheduler).

These systems utilize Storage Area Networks (SANs) for their data storage and backup needs. The following table shows the configuration of these SANs.

OIT SAN Disk Subsystems			
Quantity	Model	Cache	Disk
1	HP VA7410	2 GB	2.2 TB
1	HP VA7410	2 GB	2.2 TB
1	HP VA7410	2 GB	2.2 TB
1	HP XP256	9 GB	3.0 TB
1	EMC 8430	4 GB	1.3 TB

The following Fibre Channel switching equipment is used to support the SAN disk arrays.

OIT SAN Switch Subsystems		
Quantity	Model	Ports
2	HP Edge Switch 2/32	32
2	HP Edge Switch 2/16	16
2	EMC Silkworm 3800	16

Appendix D: System Sizing Inputs

This following worksheet contains data to be included in the State's RFP. Vendors will use this data, along with the State's platform preferences, to develop a recommended hardware configuration.

User Transaction Data					
User Type	Total Users	Peak Usage Time	Peak/Off Peak Ratio	Transaction Type/Size	Monthly Transactions per User

Converted Data		
Record Type	Years of History	
	On-Line Access	Off-Line Access

Ongoing Data Retention		
Record Type	Years of History	
	On-Line Access	Off-Line Access